APPLICATION

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TITLE: **INTERNAL VENTILATING SYSTEM FOR A ROTATING ELECTRICAL MACHINE SUCH AS A MOTOR VEHICLE ALTERNATOR**

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INTERNAL VENTILATING SYSTEM FOR A ROTATING ELECTRICAL MACHINE SUCH AS A MOTOR VEHICLE ALTERNATOR CROSS-REFERENCE TO RELATED APPLICATIONS

BACKGROUND OF INVENTION

Field of the Invention

[0001] The invention concerns an internal ventilating system for a rotating electrical machine of the type that includes, within a housing, a stator fixed-mounted in the housing and a rotor rotary-mounted in the stator; the ventilation system includes in particular at least one ventilator integrated with the rotor and capable of generating a cooling air stream within the housing, radial air intake orifices arranged in the housing and cooling air discharge ports arranged in said housing in a ring opposite the periphery of the ventilator and separated from each other by fins stiffening the housing in the area of the ports. The invention also concerns a rotating electrical machine that includes such a ventilation system.

Background Art

[0002] It has been shown that, to minimize the pressure losses caused by the fins and the noise due to the cooling fluid flows (air in this case), it is advantageous to incline them according to the direction of the air flow that must be discharged. The necessity to combine ventilator and housing is a serious disadvantage.

SUMMARY OF INVENTION

[0003] The purpose of this invention is to offer a ventilation system of the type described above, which reduces this disadvantage.

[0004] To achieve this purpose, the ventilation system in the invention is characterized in that the angle of inclination of the fins in relation to the tangent is between 38° and 52°.

[0005] Surprisingly, it has been demonstrated that such a range of angles is suitable for a large number of ventilator-housing combinations, while providing low pressure losses and a reduction

in noise. Thus, for each ventilator-housing combination, we calculate the angle of inclination and propose a range.

[0006] According to one characteristics of the invention, it is advantageous to choose the angle at a value of 45°.

BRIEF DESCRIPTION OF DRAWINGS

[0007] The invention will be understood better, and other purposes, characteristics, details and advantages of the invention will appear more clearly in the explanatory description that follows, which refers to the attached schematic drawings that are provided only as an example illustrating one method for making the invention, in which:

[0008] Figure 1 is an axial cross section of an alternator according to the state of the art;

[0009] Figure 2 is a simplified schematic view of a ventilation system according to the invention, showing a ventilator and cooling air discharge ports;

[0010] Figure 3 is a perspective of a front main bearing equipped with ventilation ports according to the invention; and

[0011] Figure 4 illustrates another advantageous characteristic of the ventilation system according to the invention;

[0012] Figure 5 is a radial view of the interior of a flat stator.

DETAILED DESCRIPTION

[0013] Referring to Figure 1, we will first describe the general structure of a ventilation system for a rotating electrical machine, in this case an alternator for an automobile, to place the invention in its context. This type of alternator is described, for example, in document FR-A-2 602 925, to which we will refer for more explanations.

[0014] On this figure, reference 1 designates a perforated alternator housing in general rotating form, which coaxially surrounds a stator 4 equipped with windings 5 within which is rotary-mounted a rotor 6 of the type with prongs that includes a shaft 7 supported by the housing through front main bearing 9 and rear main bearing 10. The

rotor is composed of two polar parts, the front one 12 and rear one 13, and a winding 14. Each polar part 12, 13 carries on its plate part a ventilator, a front ventilator 15 and rear ventilator 16. The ventilators are integrated in rotation with their respective support polar part. The stator 4 is carried in the inside by housing 1.

[0015] As shown schematically on the figure, each ventilator carries on its outside open face a number of ventilation blades 18.

[0016] Housing 1 is formed of two hollow parts called respectively front main bearing 19 and rear main bearing 21.

[0017] These main bearings are attached together, for example, with a screw 26 and each contains a part with a generally transversal orientation connected through a connection zone to a ring with an axial orientation. The main bearings carry in the center, toward their transversal part, the bearings 9, 10, and the front main bearing is adjacent to the drive pulley of the alternator, and the rear main bearing is adjacent to the rectifier bridge (not referenced) carried by the alternator.

[0018] The transversal sections of the main bearings are equipped with axial air intake orifices 20. The ring of the main bearings extends to the outside periphery of the bearings and carries the stator 4 on the inside,more specifically, the body presented by the stator to carry the windings 5. This ring is equipped with orifices 22 called ports.

[0019] The ports 22 are axially oblong and also affect the external periphery of the transversal section of the main bearing in question. The ports 22 extend on either side of the body of the stator 4 and are located outside the projecting parts, called chignon, of the windings 5 and the ventilators. The ports 22 thus contain a section with an axial orientation, called the axial orifice, that only affects the ring of the main bearing.

[0020] The axial orifices have an axial length equal to the height of a cylindrical portion of the ring delimited by a first circle corresponding to the bottom of the ports adjacent to the body of the stator and by another circle corresponding to the edge of the axial orifices of the ports. Figure 3 shows a perspective of the ports 22 delimited by fins 24.

[0021] The ventilators are configured to create a cooling air flow, the components of which are indicated by arrows, sucking in ambient air through intake axial orifices 20. A portion of the cooling air indicated by arrow F is discharged through the ports 22.

[0022] The invention concerns the internal ventilation system that essentially includes a ventilator 15 or 16 and the ports 22 to discharge the air flow created by the ventilator and illustrated by arrow F.

[0023] We will describe the invention below by referring to Figures 2 and 3. On these figures, as on Figure 1, the ventilator is designated by 16, the ventilator blades by 18, and the ventilation ports by 22.

[0024] As we see on Figure 3, on which the section of the housing that has the ports 22 is a front main bearing; the ports 22 are obtained by placing fins 24 in the appropriate orifices in the peripheral surface of the main bearing; the fins extend parallel to the axis of the alternator and are inclined in an angle predetermined in relation to the radial direction R. The function of the fins 24 is to mechanically stiffen the main bearing.

[0025] In accordance with the invention, the fins 24 present an angle of inclination of between 38° and 52°, and preferably 45° in relation to the tangent perpendicular to the radial direction. In other words, the angle of inclination in relation to the radial direction R is between (90°-38°) and (90°-52°).

[0026] Despite the general opinion that the fins must have an inclination that is substantially parallel to the direction of the cooling air flow that must be discharged through the ports, for each ventilator/housing or main bearing combination, to avoid significant pressure losses, it has been demonstrated that when inclinations in the range of 38° to 52° cited above are selected, good ventilator/main bearing compatibility is retained in a large number of such ventilator/main bearing combinations, with relatively low pressure losses and reduced air flows. Thus, the ventilation system is less noisy.

[0027] With respect to the fabrication of the ports 22 and the fins that separate them, it should be noted that the radial orifice factor of the ports must be at least 40% to the extent that an increase in the radial orifice surface significantly increases the cooling

efficiency of the ventilators, i.e. particularly electronic components in the rear main bearing of the alternator and the windings.

[0028] In order to increase the performance of the ventilation system, we increase the circumference of the axial orifices of the ports 22 so that the surface of the axial orifices represents at least 40% of the surface of the aforementioned cylindrical section of the ring.

[0029] Figure 4 shows another measurement that optimizes the cooling of the alternator. In effect, this figure illustrates that the ventilator blades should not overlap by more than a third, i.e., the distance 1 of their cord length L, the axial orifices as indicated in 20 on Figure 1 of the housing or of the front or rear main bearings. In other terms, the outside diameter of the axial orifices must be chosen on the basis of the interior and exterior diameters of the ventilator.

[0030] It is advantageous, to obtain optimized ventilation, for the fins to be arranged so that they are angularly separated by a distance D = F.360°/N in which N = the number of notches of the stator, and F is a multiplier coefficient that is determined as a function of the mechanical configuration of the electrical machine, by serial calculation.

[0031] Thus, for example,

if N = 36 notches, then 1.360°/36 = 10°. The fins are, thus, angularly separated by 10° or a multiple of 10°;

if N = 48 notches, then 2.360°/48 = 15°. The fins are angularly separated by 7.5° or a multiple of 7.5°;

if N = 96 notches, then 3.360°/96 = 11.25°. The fins are angularly separated by 3.75° or a multiple of 3.75°.

[0032] Thus, as shown on Figure 5, this configuration obtains an optimized ventilation thanks to a reduction in load losses in front of the chignons of the winding 5 rolled in grooves 32 of the stator 4.

[0033] In effect, the winding density of the front chignon 30 and the rear chignon 31 (partially shown on Figure 5 for reasons of clarity) which exit axially from the stator 4 present a maximum density above the grooves 32 and form an obstacle for the discharge of the air through the radial ports 22. Thus, according to the invention, the fins 24 are arranged to coincide angularly with these high density winding zones and not create additional obstacles in front of the air passages 34 above the teeth 33 of the stator. For this purpose, the fins 24 are radially aligned with the grooves 32 of the stator.

[0034] It is advantageous for the fins to be radially aligned on only a portion of all the grooves 32 of the stator. The pitch of the fins can be a multiple of the pitch of the grooves/teeth of the stator.

[0035] According to another method of fabrication, the fins can radially overlay the grooves 32 of the stator with a random pitch 35.

[0036] It is advantageous for at least 70% of the fins to be radially aligned with the grooves of the stator.